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Original Research Article



Economic evaluation of canola production as affected by compost and zinc application under water stress conditions

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Abstract

Canola has been introduced in Egypt recently as a promising new vegetable oil crop especially in the newly reclaimed lands usually exposed to different environmental stresses which limits their growth and productivity. Field experiment had been done Research and Production Station, National Research Centre, Nubaria location, Beheira Governorate, Egypt during 2019/2020 to study the economic analysis of compost (0, 2, 4, and 6 ton fed⁻¹) and zinc (0, 50, and 100 ppm) application on Canola production under deficit irrigation condition. Results on the effect of compost and zinc application rate and their interactions under sufficient and deficit irrigation treatment observed that application of 6.0-ton compost fed⁻¹ combined with 100 ppm Zn increased the values of seed, straw, and oil yield of canola under sufficient and deficit irrigation treatments over the remaining treatment applied and control. Increased zinc application rate from 50 ppm to 100 ppm led to an increase in the seed yield, straw yield, and oil yield of canola. The Canola plant receiving 6-ton compost in combination with 100 ppm foliar application of Zinc registered the highest gross returns, net returns, Benefit: cost ratio of seed yield, straw yield, and oil yield an oil cake yield followed by 50 ppm Zn foliar application with the same compost level as compared to other treatments and control under sufficient and deficit irrigation treatment, respectively. This practice can help to obtain higher profit over the conventional application of a recommended dose of fertilizers to the canola crop.

Keywords: Water stress, Canola, Compost, Zinc, Net returns, Benefit/costs ratio

Introduction

Egyptian Ministry of Agriculture explained that the areas cultivated with oily crops in the year 2020 amounted to 2,000 feddan of canola crop, produce about 2,800 tons of Canola oil. (*Brassica napus* L.). It is one of the most important oilseed plants that have high compatibility in resistance to drought and salinity stress. After soybean and Sunflower, the largest cultivation area of oilseed plants is accounted to canola, and in terms of oil providing after soybean and oil palm it is in third place (FAO 2005).

Like many oilseed plants, canola as affected by deficit irrigation caused by the water deficits. Studies have shown that the incidence of water deficit at different growth stages, especially reproduction and growth, is the effect of the quantity and quality of oil (Angadi and Cutforth 2003). Compost represents the most utilized form of stabilized

recycled biomass as an efficient soil amendment (Barker, 2010 and Hargreaves et al., 2008). Furthermore, compost made of animal manure is an inexpensive source of bioavailable nutrients for plants and it is progressively used in substitution of or in combination with inorganic fertilizers (Koliaei et al., 2011; Hargreaves et al., 2008). Composting organic wastes and their enrichment with a suitable amount of chemical fertilizer could enhance fertilizer use efficiency and recycle organic waste materials and organic matter into the soil, restoring soil health and improving crop yield on a sustainable basis. In another study, it was shown that the application of 100 kg N/ha with 50 ton/ha compost was adequate for optimum seed yield of canola (Kazemini et al., 2010). Zinc is an essential plant micronutrient that is involved in many physiological functions, protein, and carbohydrate synthesis (Yadavi et al., 2014). The decrease of zinc on the plant has been associated with the drought deficit irrigation caused

by decreases in soil water and consequently, restriction of root growth (Zafar et al., 2014). The application of zinc (Zn) under drought conditions would influence crop yield and quality. Zinc sulfate has an important role in the plant system to decrease water deficit irrigation, such that any secondary factor leading to the inaccessibility of this element for the plant, affects the yield and concentration of this element in various tissues (Khurana and Chatterjee 2001).

Abiotic stress such as drought might make changes in oil content and compositions in plants (Bagheri et al., 2012), due to water deficit condition often alters the composition and biosynthesis process of fatty acids leading to the reduction of oil yield and composition (Baldini et al., 2000). While Amini et al. (2014) found a positive effect of water-deficit deficit irrigation on seed quality (particularly protein) of oilseed crops. Drought tolerance is a complex trait and is mostly conditioned by many component responses, which may interact and maybe different concerning types, intensity, and duration of water deficit. Moreover, most agronomic traits are expressed differently insufficient, and deficit irrigation conditions, and are known to be affected by environmental factors (Hellal et al., 2018). The objectives of the research

work are to study the economic analysis of compost and zinc application on Canola production under water irrigation deficit conditions.

Materials and methods

Experimental procedures

Field experiments were carried out at the Research and Production Station of the National Research Centre, Nubaria region (30 30.054' N - 30 19.421' E), Beheira Governorate, Egypt during 2019/2020. Seeds of Canola (*Brassica napus*L.) cv. Saw was sown in November in the winter season. The experimental design was a split-plot with four replications. The main plots occupied by compost treatments at the rates (0, 2, 4, and 6 ton fed⁻¹) and the foliar application of zinc at a rate of (0, 50, and 100 ppm) were allocated at random in the sub-plots. The Water treatments were applied (75% and 40% of water holding capacity, WHC) as sufficient and deficit drip irrigation water systems, respectively. The plot area was 9 m². Some physical and chemical properties of a representative soil sample and compost used of the experimental site were determined before sowing according to Rebecca (2004) and presented in (Table 1).

Table 1. Some physical and chemical properties of the experimental soil and compost

| Soil pH (1:2.5) | EC dSm ⁻¹ | OM % | CaCO ₃ % | Particle size distribution | | | Texture Class |
|--|-------------------------|---------------------|------------------------|----------------------------------|-------------------------------|-----------------|------------------------------|
| | | | | Sand % | Silt % | Clay % | |
| 7.76 | 1.16 | 0.84 | 2.98 | 75.7 | 5.3 | 18.28 | Sandy loam |
| Cations (meq / L) | | | | Anions (meq / L) | | | |
| Na ⁺ | K ⁺ | Ca ⁺⁺ | Mg ⁺⁺ | CO ₃ ⁻⁻ | HCO ₃ ⁻ | Cl ⁻ | SO ₄ ⁻ |
| 3.62 | 1.41 | 3.52 | 1.48 | 0.38 | 3.81 | 1.82 | 3.44 |
| Available macronutrients (mg/100 g soil) | | | | Available micronutrients (mg/kg) | | | |
| N | P | K | | Fe | Zn | Mn | Cu |
| 15.33 | 3.98 | 16.52 | | 11.61 | 0.09 | 5.89 | 0.011 |
| Compost analysis: | | | | | | | |
| pH (1:5) | EC (1:5) | Organic Matter % | Organic Carbon % | C/N ratio | Macronutrient (%) | | |
| | | | | | N | P | K |
| 7.72 | 2.53 | 25.13 | 14.81 | 23.51 | 0.63 | 0.273 | 0.34 |

Canola plants were irrigated and maintained during the whole growth season using a drip irrigation system. Foliar spray of Zinc sulfate was applied in three doses to canola plants during the growth stage. The interaction of different concentrations of both compounds was also assessed in addition to untreated plants (control).

Yield parameters recorded at harvest

Seed yield (ton feddan)

It was obtained as the weight of clean grains of the plot after threshing, and then it was transformed into ton per feddan.

Straw yield (ton feddan)

Obtained after a process of removing the pods it was ground as the weight of the resulting straw for the piece after threshing, then turned into a ton for **feddan**.

Oil yield (ton feddan)

It was obtained by multiplying the Oil percentage by the grain yield per **feddan**.

Economic Analysis

Benefit-cost analysis was conducted to estimate the economic feasibility of canola. The production costs of canola included the cost of field preparation, seed, sowing, irrigation, fertilizers, crop protection measures and harvesting.

The gross return was estimated using the prevailing average market prices for both the grain and straw of canola in Egypt.

Net return was calculated by subtracting total expenditure from the gross income while the benefit-cost ratio was computed by dividing the gross income by total expenditure. Marginal analysis was carried out based on variable costs and prevailing market prices of canola following the procedure devised by CIMMYT (1988).

Benefit / costs ratio

It is calculated by dividing the total revenue per feddan by the total costs per feddan

$$\text{Benefit / costs ratio} = \frac{\text{Gross return (one feddan)}}{\text{Total cost (one feddan)}}$$

Statistical analysis

A combined analysis of data for the two seasons was statistically analyzed according to the technique of analysis of variance (ANOVA) for the split-plot design using MSTAT-C (1988) computer software package. The Least Significant Difference (LSD) method was used to test the differences among treatment means at a 5% level of probability as described by Walworth and Sumner (1987).

RESULT AND DISCUSSION

Yield characters

It is a key ingredient in organic farming and is one of nature’s best mulches and soil amendments, and can be used instead of commercial fertilizers. It also improves soil structure and

aeration and increases the water-holding capacity of the soil. Data in Table 2 represent the effect of compost and zinc application rate and their interactions under sufficient and deficit irrigation treatment on the values of biomass, seed yield, and oil yield of the canola plant. The obtained result revealed that the control of no compost and zinc applied gained the lowest values under both irrigation treatments. Application of 6 ton/fed compost combined with 100 ppm zinc foliar application scored the highest values of (biomass, seed yield, and oil yield).

In organic farming composts, organic manures and their extracts are used for improving soil fertility and combating pests and diseases. Regarding the effect of compost application rates on the canola yield characters under drip irrigation treatments, data on hand pointed out that the increase of compost rate associated with an increase of the studied canola yield characters under both rogation treatments. The minimum and maximum values of studied canola yield characters were observed at the control of compost (0 ton) and 6 ton, respectively. It is clear to mention that the highest reduction resulted from water stress were found at 2, 4, 6 ton for studied canola yield characters, respectively. About that, observed from data application of 6.0-ton compost fed⁻¹ combined with 100 ppm Zn increased the values of studied canola yield characters under sufficient and deficit irrigation treatments over the remaining treatment applied and control. It might be due to activation of different physiological processes like stomatal regulation, chlorophyll formation, enzyme activation, and biochemical processes through the application of compost and Zn which resulted in high yield production. The application of compost improved seed germination and yield dry matter as compared to compost-free treatments (Mc-Callum et al., 1998).

Table 2. The effects of compost and zinc on the main and by-products of canola

| Compost | Zinc | Seed yield | | Straw yield | | Oil yield | | Oil cake | |
|-----------|---------------|------------|-------|-------------|-------|-----------|-------|-----------|-------|
| | | (kg /fed) | | (kg /fed) | | (kg /fed) | | (kg /fed) | |
| | | SI | DI | SI | DI | SI | DI | SI | DI |
| 0 ton/fed | No Zn applied | 914 | 554 | 2713 | 1687 | 287.6 | 172.0 | 247.9 | 296.8 |
| | Zn 50 ppm | 953 | 593 | 2936 | 1733 | 362.3 | 198.3 | 461.4 | 307.6 |
| | Zn 100 ppm | 997 | 617 | 2990 | 1781 | 388.0 | 214.8 | 472.7 | 310.3 |
| 2 ton/fed | No Zn applied | 946 | 629 | 2814 | 1756 | 301.4 | 199.6 | 312.3 | 330.1 |
| | Zn 50 ppm | 1062 | 668 | 2882 | 1806 | 416.5 | 230.1 | 505.3 | 337.5 |
| | Zn 100 ppm | 1145 | 677 | 3007 | 1857 | 468.9 | 248.5 | 527.0 | 331.0 |
| 4 ton/fed | No Zn applied | 1313 | 684 | 2891 | 1811 | 411.6 | 234.2 | 418.6 | 365.8 |
| | Zn 50 ppm | 1346 | 728 | 3013 | 1866 | 566.7 | 265.0 | 514.3 | 357.2 |
| | Zn 100 ppm | 1388 | 751 | 3047 | 1918 | 606.3 | 288.3 | 607.5 | 354.7 |
| 6 ton/fed | No Zn applied | 1328 | 718 | 2923 | 1875 | 423.5 | 261.2 | 433.7 | 368.1 |
| | Zn 50 ppm | 1356 | 761 | 3047 | 1893 | 585.1 | 282.3 | 564.2 | 375.1 |
| | Zn 100 ppm | 1382 | 783 | 3095 | 1931 | 614.2 | 304.6 | 609.2 | 373.3 |
| LSD 0.05 | Compost | 4.88 | 5.98 | 17.95 | 20.19 | 13.06 | 10.27 | 9.34 | 8.65 |
| | Zinc | 3.66 | 4.88 | 11.02 | 5.77 | 9.18 | 8.11 | 6.45 | 4.12 |
| | Interaction | 7.93 | 10.08 | 26.88 | 24.09 | 19.64 | 16.87 | 14.23 | 11.07 |

SI: Sufficient Irrigation DI: Deficit Irrigation

With respect to the effect of compost application rates on the studied canola yield characters, data indicated that maximum values for seed yield and oil yield were (1382 kg/fed, 614 kg/fed) under sufficient irrigation and (783 kg/fed, 305 kg/fed) under deficient irrigation, recorded by application of compost at a rate of 6.0 ton fed⁻¹ with 100 ppm Zinc, followed by application 100 ppm Zn with the same compost level, respectively. While, the treatment of no fertilizer applied produced the minimum values of seed yield (914, 554 kg/fed) and oil yield (340, 172 kg/fed) under both sufficient and deficit irrigation, respectively. The positive role of compost application has been reported in many crops, gardens, and pastures. The application of compost increased microbial activity, nitrogen concentration, and grain yield (Tejada et al., 2003). The mean data of yield character of canola influenced by the application of compost application levels indicate that the maximum seed and oil yield (1355 kg/fed, 540 kg/fed) under sufficient irrigation and (754 kg/fed, 283 kg/fed) under deficient irrigation was registered in canola receiving 6-ton compost application followed by 4-ton compost and the lowest one obtained at control treatment of no applied compost under deficit irrigation.

Regarding zinc application rates and their effect on studied canola yield characters, data revealed that increased zinc application rate from 50 ppm to 100 ppm led to an increase in the seed yield, straw yield, and oil yield of canola, where the opposite was true in case of no applied zinc treatment. The increase in yield characters due to Zn foliar spraying might be attributed to the fact that Zn is known to have an important role as a metal component of enzymes or as a functional, structural, or regulatory co-factor of a wide number of enzymes (Hotz and Braun, 2004). Also, Cakmak (2008) reported that zinc plays an important role in the production of biomass. Given the above-mentioned points, it seems necessary to achieve an adequate concentration of zinc sulfate that can reduce the effects of drought stress while

meeting the plant needs; because the use of zinc sulfate increases the crop yield, promotes the quality of products, and consequently Borrell et al., (2008). The application of zinc (Zn) under drought conditions would influence crop yield and quality. It plays a significant role in regulating stomata and ionic balance in crops to reducing the detrimental effects of drought (Monjezi et al., 2013) and also has protective effects on photo-oxidative damage caused by ROS (Akbari et al., 2013).

The Economic analysis of seed yield

Water stress is one of the most important abiotic stresses that may limit agriculture production worldwide. Data in Table 3. and Fig.1 represent the effect of compost and zinc application rate and their interactions under sufficient and deficit irrigation treatment on the economic analysis of seed yield of canola plant. Data indicate the role of compost and zinc application in alleviating drought-induced changes of canola. In respect of the economic analysis of canola, among compost application, the highest gross returns (LE. 16584), net returns (LE. 7100) and Benefit: cost ratio (1.75) was observed for canola seeds received 6-ton compost with foliar Zinc application (100 ppm) under sufficient irrigation followed by 50 ppm Zn foliar application (LE. 16272, LE. 6857 and 1.73) as compared to other treatments and the lowest observed in the control treatment (LE. 10968, LE. 2505 and 1.30), respectively.

Whereas, underwater stress treatment, application of compost had increased gross returns, net returns, and Benefit: cost ratio of canola. The Canola plant receiving 6-ton compost in combination with 100 ppm foliar application of Zinc registered the highest gross returns (LE. 11860), net returns (LE. 2626), Benefit: cost ratio (1.28) followed by 50 ppm Zn foliar application (LE. 11620, LE. 2455 and 1.27) as compared to other treatments (zero and 50 ppm Zn).

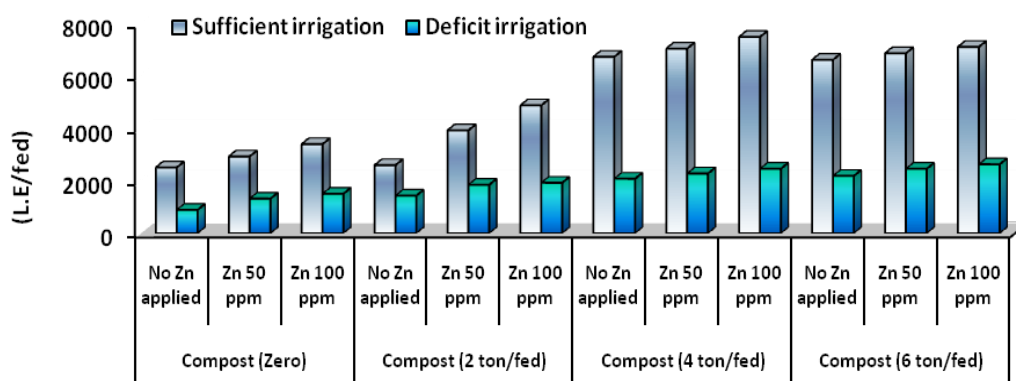


Fig. 1 Net return of seed yield as affected by compost and Zn application

The mean date of the economic analysis of canola influenced by the application of compost indicates that the maximum net returns (LE. 2421) were registered in the treatment receiving 6-ton compost, and the lowest on (LE. 1235) observed at control treatment without application of compost under deficit irrigation. Crop yield and economic benefits have claimed that using organic fertilizers results in an average of 19.8–25% lower crop yield than chemical fertilizers (Poniso et al., 2015). The proper application of chicken manure in a winter wheat-summer maize rotation system would reduce yield losses and produce much higher economic benefits than conventional systems (Liu et al., 2016 and Meng et al., 2016). This practice can help to obtain higher profit over the conventional application of a recommended dose of fertilizers to the crop.

The Economic analysis of straw yield

Data in Table 4 represent the effect of compost and zinc application rate and their interactions under sufficient and deficit irrigation treatment on the economic analysis of straw yield of the canola plant. Results indicated that the effect of compost (0, 2, 4, and 6 ton) and zinc fertilization (0, 25, 50, and 100 ppm) on the economic analysis of canola plants under water stress conditions (40 and 75% of water use

efficiency). In the case of the economic analysis of canola grown under sufficient irrigation, among the compost application, the highest gross returns (LE. 36260), net returns (LE. 25351), and Benefit: cost ratio (4.58) was observed in the treatment receiving 6-ton compost combined with 100 ppm zinc) as compared to other treatments for the canola followed by foliar application of 50 ppm Zn (LE. 35804) (LE. 25196) and (4.71), and the lowest one was observed for control treatment without compost and Zn application (LE 32556), (LE 22593) and (4.68), respectively.

Under deficit irrigation, the compost application and foliar spray of Zinc had increased gross returns, net returns, and Benefit: cost ratio of canola. The plots receiving 100 ppm zinc foliar spray combined with 6-ton compost application registered the highest gross returns (LE. 23172), net returns (LE. 12438), Benefit: cost ratio (3.00) as compared to other treatments of compost and applied zinc. The mean data of economic analysis of canola influenced by the application of compost application indicate that the maximum net returns (LE 12137) were registered in canola receiving 6-ton compost application followed by 4-ton compost (LE 12009) and the lowest one (LE 11039) obtained at control treatment of no applied compost under deficit irrigation.

Table 3. Net returns of canola seeds affected by compost and Zinc application

| Water Levels | Treatment | | Seed yield (Kg fed ⁻¹) | Total cost invested (L.E/fed) | Gross returns (L.E/fed) | Net returns (L.E/fed) | Benefit Cost ratio | T.N.I* |
|-----------------------|--------------------|---------------|------------------------------------|-------------------------------|-------------------------|-----------------------|--------------------|--------|
| | Compost | Zn levels | | | | | | |
| Sufficient irrigation | Zero compost | No Zn applied | 914 | 8463 | 10968 | 2505 | 1.30 | 0.00 |
| | | Zn 50 ppm | 953 | 8513 | 11436 | 2923 | 1.34 | 468 |
| | | Zn 100 ppm | 997 | 8569 | 11964 | 3395 | 1.40 | 996 |
| | 2 ton compost /fed | No Zn applied | 946 | 8760 | 11352 | 2592 | 1.30 | 0.00 |
| | | Zn 50 ppm | 1062 | 8824 | 12744 | 3920 | 1.44 | 1392 |
| | | Zn 100 ppm | 1145 | 8868 | 13740 | 4872 | 1.55 | 2388 |
| | 4 ton compost /fed | No Zn applied | 1313 | 9035 | 15756 | 6721 | 1.74 | 0.00 |
| | | Zn 50 ppm | 1346 | 9115 | 16152 | 7037 | 1.77 | 396 |
| | | Zn 100 ppm | 1388 | 9173 | 16656 | 7483 | 1.82 | 900 |
| | 6 ton compost /fed | No Zn applied | 1328 | 9327 | 15936 | 6609 | 1.71 | 0.00 |
| | | Zn 50 ppm | 1356 | 9415 | 16272 | 6857 | 1.73 | 336 |
| | | Zn 100 ppm | 1382 | 9484 | 16584 | 7100 | 1.75 | 648 |
| Deficit irrigation | Zero compost | No Zn applied | 554 | 8213 | 9100 | 887 | 1.11 | 0.00 |
| | | Zn 50 ppm | 593 | 8263 | 9580 | 1317 | 1.16 | 480 |
| | | Zn 100 ppm | 617 | 8319 | 9820 | 1501 | 1.18 | 720 |
| | 2 ton compost /fed | No Zn applied | 629 | 8510 | 9940 | 1430 | 1.17 | 0.00 |
| | | Zn 50 ppm | 668 | 8574 | 10420 | 1846 | 1.22 | 480 |
| | | Zn 100 ppm | 677 | 8618 | 10540 | 1922 | 1.22 | 600 |
| | 4 ton compost /fed | No Zn applied | 684 | 8824 | 10900 | 2076 | 1.24 | 0.00 |
| | | Zn 50 ppm | 728 | 8865 | 11140 | 2275 | 1.26 | 240 |
| | | Zn 100 ppm | 751 | 8923 | 11380 | 2457 | 1.28 | 480 |
| | 6 ton compost /fed | No Zn applied | 718 | 9077 | 11260 | 2183 | 1.24 | 0.00 |
| | | Zn 50 ppm | 761 | 9165 | 11620 | 2455 | 1.27 | 360 |
| | | Zn 100 ppm | 783 | 9234 | 11860 | 2626 | 1.28 | 600 |

Table 4. Net returns of canola Straw affected by compost and Zinc application

| Water levels | Treatment | | Straw yield (Kg fed ⁻¹) | Total cost invested (L.E/fed) | Gross returns (L.E/fed) | Net returns (L.E/fed) | Benefit Cost ratio | T.N.I* |
|-----------------------|--------------------|---------------|-------------------------------------|-------------------------------|-------------------------|-----------------------|--------------------|--------|
| | Compost | Zn levels | | | | | | |
| Sufficient irrigation | Zero compost | No Zn applied | 2713 | 6963 | 32556 | 22593 | 4.68 | 0.00 |
| | | Zn 50 ppm | 2936 | 7013 | 35232 | 25219 | 5.02 | 2676 |
| | | Zn 100 ppm | 2990 | 7069 | 35880 | 25811 | 5.08 | 3324 |
| | 2 ton compost /fed | No Zn applied | 2814 | 7260 | 33768 | 23508 | 4.65 | 0.00 |
| | | Zn 50 ppm | 2882 | 7324 | 34584 | 24260 | 4.72 | 816 |
| | | Zn 100 ppm | 3007 | 7368 | 36084 | 25716 | 4.90 | 2316 |
| | 4 ton compost /fed | No Zn applied | 2891 | 7535 | 34692 | 24157 | 4.60 | 0.00 |
| | | Zn 50 ppm | 3013 | 7615 | 36156 | 25541 | 4.75 | 1464 |
| | | Zn 100 ppm | 3047 | 7673 | 36564 | 25891 | 4.77 | 1872 |
| | 6 ton compost /fed | No Zn applied | 2923 | 7827 | 35076 | 24249 | 4.48 | 0.00 |
| | | Zn 50 ppm | 3047 | 7915 | 36564 | 25649 | 4.62 | 1488 |
| | | Zn 100 ppm | 3095 | 7984 | 37140 | 26156 | 4.65 | 2064 |
| Deficit irrigation | Zero compost | No Zn applied | 1687 | 6713 | 20244 | 10531 | 3.02 | 0.00 |
| | | Zn 50 ppm | 1733 | 6763 | 20796 | 11033 | 3.07 | 552 |
| | | Zn 100 ppm | 1781 | 6819 | 21372 | 11553 | 3.13 | 1128 |
| | 2 ton compost /fed | No Zn applied | 1756 | 7010 | 21072 | 11062 | 3.01 | 0.00 |
| | | Zn 50 ppm | 1806 | 7074 | 21672 | 11598 | 3.06 | 600 |
| | | Zn 100 ppm | 1857 | 7118 | 22284 | 12166 | 3.13 | 1212 |
| | 4 ton compost /fed | No Zn applied | 1811 | 7324 | 21732 | 11408 | 2.97 | 0.00 |
| | | Zn 50 ppm | 1866 | 7365 | 22392 | 12027 | 3.04 | 660 |
| | | Zn 100 ppm | 1918 | 7423 | 23016 | 12593 | 3.10 | 1284 |
| | 6 ton compost /fed | No Zn applied | 1875 | 7577 | 22500 | 11923 | 2.97 | 0.00 |
| | | Zn 50 ppm | 1893 | 7665 | 22716 | 12051 | 2.96 | 216 |
| | | Zn 100 ppm | 1931 | 7734 | 23172 | 12438 | 3.00 | 672 |

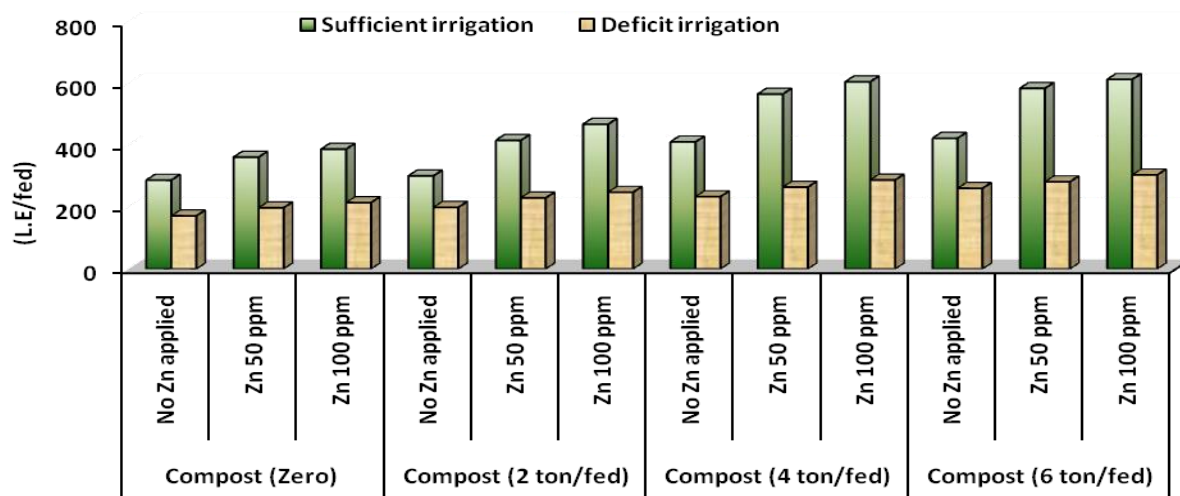


Fig. 2 Net return of oil yield as affected by compost and Zn application

Table 5. Returns of oil yield production after compost and zinc application

| Water levels | Treatment | | Oil yield (Kg fed ⁻¹) | Price Kg/LE | Net returns (L.E/fed) | Oil Cake (Kg fed ⁻¹) | Price Kg/LE | Net returns (L.E/fed) |
|-----------------------|--------------------|---------------|-----------------------------------|-------------|-----------------------|----------------------------------|-------------|-----------------------|
| | Compost | Zn levels | | | | | | |
| Sufficient irrigation | Zero compost | No Zn applied | 287.6 | 41.5 | 11935 | 247.9 | 6.5 | 1611 |
| | | Zn 50 ppm | 362.3 | 41.5 | 15035 | 461.4 | 6.5 | 2999 |
| | | Zn 100 ppm | 388.0 | 41.5 | 16102 | 472.7 | 6.5 | 3073 |
| | 2 ton compost /fed | No Zn applied | 301.4 | 41.5 | 12508 | 312.3 | 6.5 | 2030 |
| | | Zn 50 ppm | 416.5 | 41.5 | 17285 | 505.3 | 6.5 | 3284 |
| | | Zn 100 ppm | 468.9 | 41.5 | 19459 | 527.0 | 6.5 | 3426 |
| | 4 ton compost /fed | No Zn applied | 411.6 | 41.5 | 17081 | 418.6 | 6.5 | 2721 |
| | | Zn 50 ppm | 566.7 | 41.5 | 23518 | 514.3 | 6.5 | 3343 |
| | | Zn 100 ppm | 606.3 | 41.5 | 25161 | 607.5 | 6.5 | 3949 |
| | 6 ton compost /fed | No Zn applied | 423.5 | 41.5 | 17575 | 433.7 | 6.5 | 2819 |
| | | Zn 50 ppm | 585.1 | 41.5 | 24282 | 564.2 | 6.5 | 3667 |
| | | Zn 100 ppm | 614.2 | 41.5 | 25489 | 609.2 | 6.5 | 3960 |
| Deficit irrigation | Zero compost | No Zn applied | 172.0 | 41.5 | 7138 | 296.8 | 6.5 | 1929 |
| | | Zn 50 ppm | 198.3 | 41.5 | 8229 | 307.6 | 6.5 | 1999 |
| | | Zn 100 ppm | 214.8 | 41.5 | 8914 | 310.3 | 6.5 | 2017 |
| | 2 ton compost /fed | No Zn applied | 199.6 | 41.5 | 8283 | 330.1 | 6.5 | 2146 |
| | | Zn 50 ppm | 230.1 | 41.5 | 9549 | 337.5 | 6.5 | 2194 |
| | | Zn 100 ppm | 248.5 | 41.5 | 10313 | 331.0 | 6.5 | 2152 |
| | 4 ton compost /fed | No Zn applied | 234.2 | 41.5 | 9719 | 365.8 | 6.5 | 2378 |
| | | Zn 50 ppm | 265.0 | 41.5 | 10998 | 357.2 | 6.5 | 2322 |
| | | Zn 100 ppm | 288.3 | 41.5 | 11964 | 354.7 | 6.5 | 2306 |
| | 6 ton compost /fed | No Zn applied | 261.2 | 41.5 | 10840 | 368.1 | 6.5 | 2393 |
| | | Zn 50 ppm | 282.3 | 41.5 | 11715 | 375.1 | 6.5 | 2438 |
| | | Zn 100 ppm | 304.6 | 41.5 | 12641 | 373.3 | 6.5 | 2426 |

The Economic analysis of oil yield

Fertilizer management can strongly affect crop productivity under water stress conditions. Data in Table 5 and Fig.2 represent the effect of compost and zinc application rate and their interactions under sufficient and deficit irrigation treatment on the economic analysis of oil yield of canola plant. The effect of compost (0, 2,4,6 ton/fed) and zinc (0, 50, 100 ppm) application on the economic analysis of canola grown under sufficient and deficit drip irrigation systems. Results indicated that water stress has a negative effect on the economic analysis of the investigated canola. In the case of the economic analysis of barley varieties grown under sufficient irrigation (80% WHC), among the compost and zinc application levels, the highest returns of oil yield (LE. 25489) and oil cake (LE. 3960) was observed in the treatment receiving 6-ton compost per feddan soil application combined with 100 ppm Zn foliar application followed by 50 ppm Zn with 6 to compost (LE 24282-oil yield, LE 3667-oil cake) and the lowest one was observed for the control treatment (LE 11935-oil yield, LE 1611 oil cake), under sufficient irrigation regime.

Under deficit irrigation (40% WHC), the nutrient management application had increased returns of canola plants. The treatment receiving 6-ton compost per feddan soil application combined with 100 ppm Zn foliar application registered the highest returns of oil yield (LE 12641), oil cake (LE. 2426) as compared to other compost application treatments, and the lowest oil yield (LE 7138), oil cake (LE. 1929) observed for control treatment of no applied Zn and compost. According to the mean data, the economic analysis of canola grown under deficit irrigation (40% WHC), among the compost management application, the highest returns of oil yield (LE. 11732 form 6-ton compost), followed by(LE. 10894 form 4-ton compost) and (LE. 9382 form 2-ton compost) and the lowest one (LE. 8094 form 0-ton compost). Whereas the highest return oil cake (LE. 2419 form 6-ton compost), followed by (LE. 2335 form 4-ton compost) and (LE. 2164 form 2-ton compost) and the lowest one (LE. 1982 form 0-ton compost).

Conclusion

Economic analysis of canola influenced by nutrient management application of compost and zinc indicate that, the maximum net returns were registered for canola receiving (6-ton compost combined with 100 ppm Zn) under deficit irrigation. The wise use of integrated organic sources of nutrients as compost minimizes the cost of chemical fertilizers and improves the efficiency of added fertilizers and maintains soil health besides supplying nutrients to crops for higher seed and oil productivity of canola. This practice can help to obtain higher profit over conventional application of a recommended dose of fertilizers to the crop.

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Conflict of Interest

The author hereby declares no conflict of interest.

Consent for publication

The author declares that the work has consent for publication.

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